

LMQXB Production Test Plan

June 19, 2001

0.1 Outline

Test Cycle I

In this test cycle all the procedures will be done for Q2A and Q2B separately.

- Magnetic measurements
- Room Temperature Pretest and Cool down
- Between 4.5K and 1.9K
Pre-Current excitation Checkout
- At 1.9K Operation
3000 amp and 670 amp tfn test
Quench training (to get above 230 T/m)
Magnetic measurements

Test Cycle II

In this test cycle Q2A and Q2B will be connected to the power leads as a single Q2 unit

- Between 4.5K and 1.9K
Pre-Current excitation Checkout
- At 1.9K Operation
3000 amp tfn test
Quench varification (to get to 220 T/m without quenching)
Ramp rate studies - one quench at 300 A/sec
- Magnetic measurements (at room temp.)

0.2 Test cycle I

0.2.1 Magnetic measurements

1. The magnet is located at Stand 4
 - (a) Harmonics and stretched wire measurements (details of the measurements will be determined later)

0.2.2 Room Temperature Pretest/Cooldown

1. Follow present procedures for voltage taps, thermometer, and heater validation. Procedures include:
 - (a) Hi pot the magnet in gaseous He environment. Maximum volts should not exceed $V_{max} = 1400V$ value.
 - (b) 4 wire heater resistance, system resistance for two heater circuits.
2. Cool down to 80K, then change strain gage and thermometer readings to 1 minute intervals. Cool to 4.5 K , 1.1 ATM with unrestricted cooldown following Stand 4 cool-down procedure.

0.2.3 During 4.5 K to 1.9 K cool down

1. Cold electrical tests prior to magnet testing
 - (a) Check magnet resistance to ground.
 - (b) Hi pot (1.1 ATM helium). Maximum volts should not exceed $V_{max} = 1400V$ value.
 - (c) Protect magnet with a 60 m Ω dump resistor. $I_{max} * R_{dump} \leq 1000V$
 - (d) Conntct Q2A to the power leads
 - (e) Heater Pretests
 - i. Configure QLM to fire heater with 1 sec dump firing delay
 - ii. Check outer heater and heater system resistance using 4 wire techniques. System capacitance should be set to approximately 7 mF.

- iii. Verify that outer heaters are connected to SHFU's.
- iv. Fire outer heaters from HFU gui. Verify RC, V heaters, I heaters from data logger plots
- (f) Disable Digital QDC (or set to high thresholds)
- (g) Balance quench detection circuitry for analog QDC
 - i. Set dump delay to 0 sec
 - ii. sawtooth ramps between 50 A and 450 A at 100 A/sec and 300A/s
 - iii. Establish thresholds based on observed noise versus anticipated signals.
- (h) Balance quench detection circuit for DQDC
- (i) Set dump delay to 25msec and the heater delay to 0msec. Manual trip at 1000 A. **Every single analog QDC platform has to be checked separately. Power supply, dump switch, heater and interlock respond should follow the proper quench logic.** Delay heater firing to 1 sec dump delay = 0 sec. Do another manual trip and check L/R, look at all data logger voltage signals; compare V_{max} to $I * R_{dump}$

0.2.4 At 1.9K Operation

1. Quench Heater Protection test

- (a) Tfn test. It must be performed for both heater circuits
 - i. Set dump resistor delay to 0 ms, no heater delay, no power supply phase off delay
 - ii. At 3000A magnet current, fire the SHFU at 900V and check that the t_{fn} value is less than 200 ms and all four quadrant are quenched
 - iii. Check quench logic signal for proper quench timing sequence

2. Quench training

With ramp rate = 20 A/sec, train the magnet. If the quench current produce more than 230 T/m field gradient do not do more quenches.

3. Magnetic measurements

The default ramp rate is 20 A/sec.

The nominal data set is 25 rotations of the coil.

All measurement sequences should begin with a “cleansing” quench at $\sim 10000\text{A}$. A cleansing quench is done by firing the magnet heaters with magnet current high enough to produce a small remnant field.

- (a) Set the heater delay to 0 msec, dump delay to 0 msec, and dump resistance to $60\text{ m}\Omega$.
- (b) Determine the minimum magnet current for a cleansing quench: check the effect of a cleansing quench at 10000 A by checking the remnant magnetic field. If the remnant field is substantial increase the current and quench the magnet again. Repeat this procedure until the minimum current is found. Use this value of the current for all cleansing quenches needed for this test plan.
- (c) Take harmonics and stretched wire measurements (details of the measurements will be determined later)

0.3 Test cycle II

Connect Q2A and Q2B to the power leads as a single Q2 unit

0.3.1 Magnetic measurements

1. At Stand 4
 - (a) Take harmonics and stretched wire measurements (details of the measurements will be determined later)

0.3.2 During 4.5 K to 1.9 K cool down

1. Cold electrical tests prior to magnet testing
 - (a) Check magnet resistance to ground.

- (b) Hi pot (1.1 ATM helium). Maximum volts should not exceed V_{max} value (to be determined).
- (c) Protect magnet with a 60 m Ω dump resistor. $I_{max} * R_{dump} \leq 1000V$
- (d) Repeat procedures from 0.2.3 1f through 1i.
- (e) Set dump delay to 25msec and the heater delay to 0msec. Manual trip at 1000 A. **Every single analog QDC platform has to be checked separately. Power supply, dump switch, heater and interlock respond should follow the proper quench logic.**

0.3.3 At 1.9K Operation

1. Quench Heater Protection test (t_{fn} test)
 - (a) Set dump resistor delay to 0 ms, no heater delay, no power supply phase off delay
 - (b) At 3000A magnet current, determine voltage required to quench heaters with $t_{fn} < 200$ ms
 - (c) Check quench logic signal for proper quench timing sequence
2. Quench Training

With ramp rate = 20 A/sec ramp the magnet up to 220 T/m and down to 0. If the magnet quenches repeat the above test.
3. RAMP RATE dependence studies.

Ramp to quench at 300 A/s,
4. Magnetic measurements

Repeat Test cycle I procedures, as desired.
5. Heater studies
 - (a) For heater study the default setting for the dump resistor delay is 1 s, no heater delay, no power supply phase off delay.

- (b) Set SHFU to 900V voltage value. Ramp the magnet up to 12000A and initiate a manual trip.
- 6. Ramp up the current until the magnet reach 220 T/m with 20 A/s ramp rate. If the magnet doesn't quench slowly ramp down the PS.
- 7. Warm magnet measurements
 - (a) Take harmonics and stretched wire measurements (details of the measurements will be determined later)